

Observational Studies of the Exospheres of the Moon and Mercury

NASA Johnson Space Center
Houston, Texas 77058

Andrew Potter
Thomas Morgan

Strategy

The sodium and potassium atmospheres of Mercury and the Moon are mapped using spectroscopic measurements of resonance scattered sunlight. The objective is to define the sources and sinks for these atmospheric constituents, and in so doing, provide a better understanding of atmospheric processes on these bodies, which are unique in that their atmospheres consist solely of an exosphere with the planetary surface at its base.

Progress and Accomplishments

We published images of sodium D₂ emission for Mercury, and interpreted the non-uniform and changeable distribution of sodium as the result of magnetospheric processes driven by solar activity.

We continued observations of Mercury, and obtained data during three runs in 1990. The December 1990 run was outstanding in quality and duration (6 days), and for the first time, we observed both sodium and potassium distributions on the same day. We expect to learn more about the mechanisms controlling the Mercury atmosphere from comparison of the sodium and potassium distributions.

We completed the analysis of lunar sodium distribution from three observing runs in 1989 and 1990. We found sodium emission up to an altitude of 1500 km. over the sunlit equator. The apparent temperature of the sodium above the equator was 950-1150°K. Above the north pole, the temperature dropped to about 450°K. An extensive (6 night) lunar observing run was completed in December 1990, which covered the range from full moon past third quarter.

Projected Accomplishments

We will complete the analysis and interpretation of the same-day sodium and potassium distributions on Mercury that were obtained in December 1990. Our explanation of the variable distribution of sodium on Mercury is that solar activity influences the magnetosphere of Mercury, which in turn influences the sodium distribution. We have initiated a synoptic program of Mercury sodium observations at the McMath telescope, which will generate a substantial body of new data to test this hypothesis.

We will complete the analysis of the December 1990 body of lunar sodium data, and will continue lunar measurements as observing time is available. We also plan to explore techniques for mapping the entire sodium exosphere of the Moon, using coronagraphic techniques.

Publications

Potter, A.E. and T.H. Morgan. "Evidence of Magnetospheric Effects on the Sodium Atmosphere of Mercury" *Science*, **248**, 835-838 (1990)

Killen, R.M., A.E. Potter, and T.H. Morgan. "Spatial Distribution of Sodium Vapor in the Atmosphere of Mercury" *Icarus*, **85**, 145-167 (1990)

Potter, A.E. and T.H. Morgan, "Variation of the Lunar Sodium Atmosphere with Phase and Location" *B.A.A.S.*, **22**, 1046 (1990)